FORM B

UNIVERSITY OF MASSACHUSETTS AMHERST
OFFICE OF THE SECRETARY
THE FACULTY SENATE

UNDERGRADUATE COURSE APPROVAL FORM
(Courses Numbered 001-599)

15 Copies Required for Courses Numbered 001-499
20 Copies Required for Courses Numbered 500-599

1. **DEPARTMENT, COURSE NUMBER AND TITLE:** Civil and Environmental Engineering, 250, Thermodynamics, Heat Transfer and Energy Systems

2. **SCHOOL OR COLLEGE:** Engineering

3. **Proposer's Name, Telephone and Email:** David Ahlfeld; 545-2681; ahlfeld@ecs.umass.edu

4. **Proposed Instructor:** Prof. Ahlfeld in first several years with others in Department teaching in later years.

5. **Course Credits:** Three

6. **Are there Prerequisites?** Yes **If yes, please specify**

   Pre-requisites: Phys 151/153 and Math 132
   Co-requisites: Phys 152/154 and Math 233

7. **What is the intended clientele?** Lower Division Sophomore Upper Division

   Department majors only Yes Departmental/related majors Non-Majors

   If course is intended for majors, what role will it play in the curriculum? Required Yes Elective No

8. **Complete Course Catalog Description (30 Words):**

Fundamentals of thermodynamics, conservation of mass and energy, control volume analysis. Heat engines, heat pumps, Carnot cycles, entropy, process efficiencies. Heat transfer mechanisms. Applications to civil engineering facilities.

9. **Please attach the following materials:**

   _____ Week-by-week outline of topics covered in course (or syllabus)
   _____ List of Required readings
   _____ Description of required assignments (papers, exams, projects, reports, presentations, etc.)
   _____ Summary of course grade criteria
   _____ Selected bibliography of works used by instructor in developing course, especially recent works (as appropriate)

10. **If course has been offered as an experimental or special topics course, please comment (on an attached page) on its evolution.**

See next page

Upon approval of the course by the department head, one copy of this form shall be sent from the departmental office to the Faculty Senate Office to allow for the course to be published on the University's Web Site for comment.

For courses numbered 500-599, the "Guidelines for Course Approval Form" from the Graduate Council must accompany the new course proposal.

Response to Questions 9 and 10 for CEE 250

9. Please attach the following materials:

_____ Week-by-week outline of topics covered in course (or syllabus)

Please see syllabus for topics covered.

_____ List of Required readings

Most readings are from the textbook – see syllabus for referenced sections. Occasional handouts are distributed relating to current events that involve energy systems.

_____ Description of required assignments (papers, exams, projects, reports, presentations, etc.)

The course has two midterms, a final exam and near-weekly homework assignments (10 in total). All exams and homeworks are graded on a numerical scale.

_____ Summary of course grade criteria

The numerical scores from all exams and homeworks are combined into a single numerical score for the course using the following weighting.

Activity	*% of grade*
Exam 1	25%
Exam 2	25%
Final Exam	35%
Homework	15%

The final course grade is assigned based on the final numerical score with a grade breakdown as follows: A – 90 and above; B 80 to 89; C 70 to 79; D 60 to 69; F 59 and below. Plus and minus grades are added for point totals within 3 points of the indicated breakpoint.

_____ Selected bibliography of works used by instructor in developing course, especially recent works (as appropriate)

This course combines traditional thermodynamics for thermal applications with traditional heat transfer analysis with an emphasis on science and applications relevant to civil engineers. Excellent textbooks exist in both thermodynamics and heat transfer and were consulted in designing the course. The selected text covers both topics with ample examples and problems related to civil engineering.

10. If course has been offered as an experimental or special topics course, please comment (on an attached page) on its evolution.

The course has been offered as CEE 290T in Spring 2008 and Spring 2009. Since its first conception, the course has changed only slightly with a bit more emphasis on heat transfer in buildings and transient heat transfer analysis. Additional instruction on current challenges that relate to energy systems (e.g. climate change, emergence of renewable energy) has also been added.

The textbook by Cengel has been excellent and will be retained for the proposed course.

Typical Syllabus for Proposed Course

Dept. of Civil and Environmental Engineering
University of Massachusetts
CEE 250 – Thermodynamics, Heat Transfer and Energy Systems
Fall 2009

Instructor: David Ahlfeld
Office: Marston 12A
Phone: 545-2681
Mailbox: Marston 18
E-mail: ahlfeld@ecs.umass.edu
Office Hours: MWF 11 and M 3-5PM

Catalog Description:
Fundamentals of thermodynamics, conservation of mass and energy, control volume analysis. Heat engines, heat pumps, Carnot cycles, entropy, process efficiencies. Heat transfer mechanisms. Applications to civil engineering facilities.

Required Text: Introduction to Thermodynamics and Heat Transfer, Yunus A. Cengel, McGraw Hill, 2008, 2nd Edition

Pre-requisites: Phys 151/153 and Math 132
Co-requisites: Phys 152/154 and Math 233

Course Outcomes:
At the conclusion of the course the student shall have:
1) an understanding of the role of civil and environmental engineers in reducing society's energy use and increasing the use of non-fossil energy sources
2) experience with the use of control volumes for mass and energy balance analysis
3) ability to apply 1st and 2nd Law of Thermodynamics to solve engineering problems
4) the ability to perform steady-state conductive heat transfer analysis for a building
5) experience with convective, radiative heat transfer mechanisms and transient heat transfer analysis
6) an understanding of devices and facilities for energy production, heating, cooling and heat transfer

Course Requirements and Grading Criteria:

Activity	*Date*	*% of grade*
Exam 1	TBA	25%
Exam 2	TBA	25%
Final Exam	TBA	35%
Homework		15%

Examination Policy:
Exams and quizzes must be taken at the scheduled time. Exceptions will be made only under the most extreme circumstances. Make-up exams will be scheduled at the instructors convenience. No make-ups are possible on the quizzes.

Homework Policy:
Approximately 10 homework sets will be distributed. At the time of quizzes and exams students are responsible for all material contained in the homework sets distributed up to that time. Solutions to all assignments will be posted. Most of the homework sets will be collected, graded and returned at the next class meeting. No late homeworks will be accepted. It is anticipated that students will work together to review class material. All students must submit independently completed

homework assignments. Credit will be deducted for homework submitted that does not clearly show the process used to arrive at the solution.

Class Participation:
A productive academic atmosphere requires full participation, mutual respect and trust. Attendance is expected at all class meetings. Repeated absence from class may result in grade reduction. The provisions on academic honesty described in the Code of Student Conduct will be strictly enforced.

Time Period	**Course Topics**	**Text Chapter and Sections**
Week 1	Introductory material; energy transfer and conversion	1 and 2
Week 2	Control volumes; mass and energy conservation	6-1, 6-3
Week 3	Forms of energy; heat transfer, work	3-1 to 3-5
Week 4	Energy transfer in flowing fluid; properties of pure substances	4, 6-2, 6-4
Week 5	1st Law applications to liquid water; device efficiency	3-6 to 3-8
Week 6	Cyclic processes; heat engines; enthalpy	5, 7-1 to 7-3
Week 7	Properties of steam; application to steam power plants	4-4, 4-5
Week 8	Refrigeration and heat pump cycles; system efficiency	7-4 to 7-6
Week 9	Carnot cycles; entropy; 2nd Law of Thermodynamics	7-7 to 7-11, 8
Week 10	Discrete and differential forms of conservation laws	6, 7 and 8
Week 11	Heat transfer mechanisms: Conduction, convection and radiation; heat exchangers	9
Week 12	Conduction through planes and cylinders	10
Week 13	Building energy demands	10 and 11
Week 14	Transient heat transfer analysis for buildings	11